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ABSTRACT

Thirty teachers and 718 students in grades 4, 5, and 6 in Edmonton, Alberta participated in a study to determine the value of simultaneous one-way television and group telephone conferencing (compared to conventional instruction) for teaching LANDSAT imagery. Results indicate that: (1) a 5-hour instruction period is sufficient to train elementary school teachers to teach their students to interpret color 1 LANDSAT imagery on an introductory level for class use; (2) there are small but significant differences favoring male over female students (in TV-telephone group) on an achievement test; (3) some students appear to emphasize color over pattern or shape in interpreting color 1 LANDSAT imagery ground truth (suggesting that teachers emphasize the role that pattern, color, and shape play in ground-truth interpretation; (4) there is confusion among students in distinguishing snow and clouds in the LANDSAT imagery; and (5) that a grid procedure test map is less precise than one-to-one oral testing or the marking of arrows or circles to identify features on LANDSAT imagery. In addition, results of the achievement test confirm previous research indicating that elementary school students are capable of working with LANDSAT color 1 images. (JN)

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A LANDSAT COLOR 1 IN-SERVICE TRAINING PROGRAM FOR ELEMENTARY SCHOOL TEACHERS AND THE MASS TESTING OF THEIR 718 PUPILS†

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by J.M. Kirman and J. Goldberg

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RÉSUMÉ

Les données obtenues indiquent que les instituteurs peuvent apprendre, en une période relativement courte de formation pratique à enseigner les rudiments de l'imagerie LANDSAT couleur 1. Les recherches démontrent aussi qu'il existe une différence sensible, quoique minime, entre les élèves de sexe masculin et de sexe féminin des écoles primaires dans l'interprétation des images LANDSAT couleur 1, et confirment que ces élèves peuvent travailler avec des images couleur 1.

SUMMARY

Data indicate that elementary school teachers can learn to teach about LANDSAT color 1 imagery in a relatively short in-service training period. The research also provides evidence that there is a significant, but small, difference between male and female elementary school children in interpreting LANDSAT color 1 images, and confirms the ability of elementary school children to work with color 1 images.

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LANDSAT imagery was the subject of a recent research project that attempted to determine the value of simultaneous one-way television and group telephone conferencing for teaching[1]. Thirty teachers and 718 children in grades 4, 5 and 6 participated in the project, making it the largest elementary level LANDSAT instruction program undertaken to date. The project was an outgrowth of a previous project by the authors[2], and the data cited in this article was prepared September 10, 1980 as a supplementary report to the sponsoring agency.

Because of its relative newness, LANDSAT imagery was the ideal instruction topic. Almost all the teachers were unfamiliar with LANDSAT imagery and were highly dependent upon the instructor and materials provided. The children also had no background for this topic. This last item was critical since a major test of the in-service training program was the ability of the children to interpret LANDSAT infra-red false color images after their teachers had taught them a LANDSAT unit.

For purposes of evaluating the delivery system, the teachers were divided into two groups of fifteen each. One group was in the city of Edmonton and received face to face instruction, while the other group of teachers using the TV-telephone procedure was located in Sherwood Park, Alberta, a residential area just outside of Edmonton. Both groups received the same instruction by the same instructor and received identical materials. Each group received five hours

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of instruction within a two week period: two 2-hour sessions the first week on basic LANDSAT instruction, and one 1-hour session the following week to raise questions about the topic. At the final session, a representative of the Alberta Remote Sensing Center accompanied the instructor to answer any technical questions.

The teachers were to begin a unit on LANDSAT infra-red imagery at the beginning of the second week. Prior to this, they were to survey their pupils for any knowledge of LANDSAT image interpretation. No teachers reported any prior pupil knowledge of LANDSAT imagery. When the children had completed their units, the instructor gave an achievement test and provided the teachers with a questionnaire about the in-service instructional system.

All were experienced teachers, but the face to face lecture group held a slight edge in age and experience. The numbers of children in each grade level are found in Table 1.

Table 1

Number of children in each grade level

	TV-telephone group (N = 365)	Face to face group (N = 353)	Total (N = 718)
Grade 4	86	69	155
Grade 5	157	121	278
Grade 6	122	163	285

The materials used by the teachers for training and instructional activities were class sets of rulers, magnifying glasses, acetate covers to protect the LANDSAT imagery, china markers for writing on the acetates, and offset duplicated road maps of the Winnipeg, Manitoba region. Because of the high cost of LANDSAT imagery, teachers were provided with a published teaching kit[3] consisting of 45 pages of color I LANDSAT imagery in a looseleaf binder with background and teaching information. The kit contains 15 Winnipeg snow cover images of December 6, 1975, path 33, row 25, and 15 Winnipeg vegetation cover images of August 26, 1976 of the same path and row. The remaining 15 sheets contain images of different areas of the world: some are cropped so that up to three images are on one sheet. All images are at a scale of 1:1 000 000.

As part of their in-service training, the teachers viewed two video tapes and received hands-on instruction with the teaching kit. One video tape was the NASA film *Remote Possibilities* giving a general introduction to LANDSAT image production and applications. The second video tape was *Eye in the Sky*, a specially produced 42-minute teacher education tape discussing the pedagogical uses of LANDSAT imagery and showing elementary school age children using them*.

The teachers taught their LANDSAT unit for approximately three weeks. There was no required procedure for them to follow, but the instructor did give the teachers some general approaches she had found successful with her grade three class. She suggested having the children make a LANDSAT folder, making up ditto sheets for class exercises with LANDSAT images, orienteering with the road map and marking locations on the LANDSAT image. Children were expected to work together in groups of two's and three's since they would not only help each other, but be able to discuss what they were doing. This latter approach had been used in previous LANDSAT research with elementary school children[4].

* Dubs of this video tape may be obtained by sending a one hour video tape to Mr. Dave Mappin, Audio-Visual Media Center, Faculty of Education, University of Alberta, Edmonton, Alberta, Canada T6G 2G5. The service is free for schools and educators within Alberta. There is a prepaid charge of $15.00 for those outside Alberta.

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The pupils were tested with an infra-red false color image of the Calgary, Alberta, region of July 15, 1974, path 46, row 24. The image was divided into a grid of 25 numbered boxes. The children received a thirteen item multiple choice achievement test. The vocabulary was geared to the children's level. Where children were requested to find a particular item on the image, they were to select the numbered box in which the item appeared. They had a choice of four boxes. The following are the achievement test items and the percentage of correct responses from each of the two groups of children:

	TV-telephone	Face to face
1. Find a city	85	83
2. Find a river	98	98
3. Find clouds	90	92
4. Find roads	69	62
5. Find farmland	64	64
6. Find mountains	88	87
7. Find a lake	54	52
8. Find snow	65	65
9. What is the white in Box 8? a. snow c. clouds b. water d. cleared farmland	63	58
10. The color red on this map means a. green plant c. hot land b. red land d. red plants	89	86
11. How was this map made? a. by an airplane c. by a satellite b. by an astronaut d. by radar	96	94
12. Pick the box that has a lake or river with very clear water	41	32
13. Pick the box that has the largest number of growing plants in it	87	85
$\bar{\Sigma}$	76	74

It is the author's belief that a superior procedure for testing would have been first, a one to one oral examination in which the child points to the specific LANDSAT map feature and gives reasons for doing so, or secondly, having each child circle or place an arrow directly on the image. Given the number of pupils, budget constraints precluded additional salary for one to one testing or outlay for individual imagery and salary for evaluators to examine them. The grid procedure had previously proven to be usable for general pupil testing, although it is far less precise than the aforementioned procedures.

Thus, since the project mainly concerned the in-service delivery system, the grid procedure was the least time consuming and lowest cost one that would be capable of showing a difference between pupils.

The results of the achievement test indicate that the TV-telephone delivery system worked and the in-service procedures were effective. The results also confirmed the capabilities of elementary school age children to work with infra-red false color LANDSAT imagery. However, the lower average scores by the children on questions 4, 5, 7, 8, 9, and 12 merit discussion.

These questions were analysed by examining the frequencies of the incorrect answers to determine what the children thought were the correct responses. Thus for question 4, "Find roads", where the correct selection was a box with an obvious grid of roads in it, the incorrect responses appeared to have been the selection of boxes with meanderings between mountains. The possibility exists that some of the children may have identified roads following the course of rivers, but this seems to be a bit too sophisticated for elementary level children, especially when the correct box's roads were so obvious.

In question 5, "Find farmland", the incorrect response seemed to be the darkest red box. Perhaps this is related to red being the color of growing green plants. Some of the children may have been looking for the spectral signature of growing plants rather than the land pattern of farmland: the redder the better.

For question 7, "Find a lake", the next largest number of children with an incorrect response selected a box with a wide section of the Columbia River in it. This is a clear case of confusion of shapes of bodies of water.

"Find snow" was question 8. Here confusion occurred between snow and cloud cover. This again occurred in question 9, "What is the white in box 8?", with the choices being snow, water, clouds or clear farmland. If that was the case, the cloud shape was ignored in favor of the color.

The answers to questions 8 and 9 should be compared to question 3, "Find clouds". For that item the correct responses of the children averaged 91%, even though two of the incorrect selection boxes contained snow cover. Perhaps there was little difficulty with question 3 since the clouds may have been more 'cloud-like' to the children, e.g. more spread out without distinct edges, whereas the clouds in question 9 were small with distinct edges.

Question 12 was "Pick the box that has a lake or river with very clear water". The low average scores showed there was difficulty with this. The two most frequently selected wrong boxes contained bodies of water also, so that the possibility exists that there may have been confusion about the spectral signature of clear water. With hindsight, this could probably have been double checked with questions asking the children for the spectral signature of clear water and sedimented water.

One other possibility for an incorrect response for question 12 may have been that box 18, the correct response, was already used as a correct response for question 7. Perhaps some children may have thought that a box could be selected only one time for a correct answer. However, this presumption may not be valid since a small minority selected box 14 as an incorrect response to question 12 even though it was selected as a correct response for question 2 by 98% of the students. Previous use of the grid procedure did not indicate this to be a problem. A one to one oral examination rather than the written grid image test could have possibly determined this.

In examining the data from the children's achievement test, no significance was found between grade levels. A significant difference was observed between male and female performance on the children's achievement test as noted in Table 2.

Table 2

Male and female differences on children's achievement test

	TV-telephone group			Face to face group		
	*N	$\bar{X}$	SD	N	$\bar{X}$	SD
Female	170	9.494	2.007	165	9.230	2.188
Male	191	10.257	1.995	188	9.888	2.033
	$P < 0.00032$ (two failed test)			$P < 0.0036$ (two failed test)		

* Four children in the TV-telephone group did not respond to the item of sex identification

In each grade level in both the face to face group and the TV-telephone group, the boys' scores were higher than the girls' scores on the achievement test, although not all the score differences were significant. With the TV-telephone group the male-female differences were significant on all grade levels (Table 3).

While this superior male performance cannot be readily explained, it may be consistent with research showing male superiority on spatial orientation skills, including map reading[5]. Assuming the correctness of this, an educational implication may be that in teaching females about LANDSAT maps, the teacher should present the spatial relations cues to them in a very methodical fashion to facilitate identification.

Table 3

Male-female differences on children's achievement test by grade level

	Face to face group			
	Female	**Male**	**p**	
Grade 4	8.59	9.19	0.20	N.S.
Grade 5	8.59	10.00	0.0001	Significant
Grade 6	9.96	10.13	0.61	N.S.
	TV-telephone group			
	Female	**Male**	**p**	
Grade 4	8.42	9.4	0.025	Significant
Grade 5	9.68	10.34	0.038	Significant
Grade 6	10.05	10.73	0.04	Significant

The findings of this project for remote sensing education are:

1. A five hour instruction period with the materials used in this project is sufficient to train elementary school teachers to teach their pupils to interpret color I LANDSAT imagery on an introductory level for class use.
2. There appears to be a small but significant difference favoring males over females on the achievement test in this project.
3. The results of the achievement test confirm previous research indicating elementary school pupils are capable of working with LANDSAT color I images.
4. Some elementary school pupils appear to emphasize color over pattern or shape in interpreting color I LANDSAT imagery ground truth. Teachers should emphasize that all three — color, pattern, and shape — play a role in ground-truth interpretation.
5. There appears to be confusion by some pupils in distinguishing between snow and clouds in color I LANDSAT imagery. Emphasis must also be placed on differentiating between cloud and snow cover. However, unless meterological considerations are involved with the instruction, a more pragmatic procedure might be to point out cloud cover directly on specific images used with the children. This approach is suggested since LANDSAT images are usually used for ground-truth instruction rather than meterological purposes, and it may not be worth the time involved to teach about snow-cloud differences. A further consideration is that we have no research on the capabilities of elementary school children to make such differentiations, although some in this project were able to do so.
6. A grid procedure test map is less precise than one to one oral testing or the marking of arrows or circles to identify features on LANDSAT imagery

Suggestions for further research:

— What method might be used to teach elementary school children awareness that color and shape play a role in determining ground-truth conditions on LANDSAT color I images?

— Can elementary school children learn to differentiate between snow and cloud cover on LANDSAT color I images? If so, what instruction might be used?

— Does the significant difference in male-female scores have any implications for LANDSAT color I image instruction with elementary school children?

LANDSAT images in the elementary school classroom are relatively new. They were probably not used earlier because of doubts that youngsters could understand them, and because teachers were not familiar with them. But children can obtain an introductory working knowledge of color 1, and it is not too difficult for teachers to learn to use LANDSAT images. That we live in the dawn of the space age is now a cliché, but a very true one. To prepare our children for tomorrow's world we must teach them to use the tools they will need. The map skills demonstrated in this study are ready to be put to use with LANDSAT color 1 imagery.

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